EXHIBIT 7

[redacted]

UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

TQ DELTA, LLC,

Plaintiff,

v.

COMMSCOPE HOLDING COMPANY, INC., COMMSCOPE, INC., ARRIS US HOLDINGS, INC., ARRIS SOLUTIONS, INC., ARRIS TECHNOLOGY, INC., and ARRIS ENTERPRISES, LLC,

Defendants.

Civil Action No.: 2:21-cv-310

[redacted]

RESPONSIVE EXPERT REPORT OF DR. NIEL RANSOM ON NON-INFRINGEMENT OF THE FAMILY 2, 3, 6, 9A AND 9B PATENTS

Delay	Definition
max_delay_octet$_{DS,0}$	maximum allowed end-to-end delay, in octets, resulting from the combination of the VTU-O's interleaver and the VTU-R's deinterleaver for the downstream latency path 0
delay_octet$_{DS,0}$	actual end-to-end delay, in octets, that results from the combination of the VTU-O's configured interleaver and the VTU-R's configured deinterleaver for the downstream latency path 0 delay_octet$_{DS,0}$ ≤ max_delay_octet$_{DS,0}$
max_delay_octet$_{US,0}$	maximum allowed end-to-end delay, in octets, that results from the combination of the VTU-R's configured interleaver and the VTU-O's configured deinterleaver for the upstream latency path 0
delay_octet$_{US,0}$	end-to-end delay, in octets, that results from the combination of the VTU-R's configured interleaver and the VTU-O's configured deinterleaver for the upstream latency path 0 delay_octet$_{US,0}$ ≤ max_delay_octet$_{US,0}$

157. G.993.2 states that the minimum amount of memory the VTU-O or the VTU-R must use to meet each of the delay_octet values is half of the specified delay. *See, e.g.*, *id.* § 6.8.2 ("Each interleaver and each de-interleaver for each latency path requires at least (delay_octet$_{[DS/US],[0]}$/2) octets of memory to meet this delay.") (emphasis added). In other words, the values of delay_octet$_{DS,0}$ and delay_octet$_{US,0}$ establish only lower bounds on the amounts of memory that the VTU-R and VTU-O must actually use for interleaving and deinterleaving. Specifically, the VTU-R's deinterleaver requires at least delay_octet$_{DS,0}$/2 of memory for deinterleaving and its interleaver requires at least delay_octet$_{US,0}$/2 of memory for interleaving. Similarly, the VTU-O's deinterleaver requires at least delay_octet$_{US,0}$/2 of memory for deinterleaving and its interleaver requires at least delay_octet$_{DS,0}$/2 of memory for interleaving.

158. Thus, once the VTU-O's and VTU-R's interleavers and deinterleavers have been

configured, the following relationships hold:

- delay_octet$_{DS,0}$/2 = ***minimum*** *amount of memory in use* by VTU-O interleaver
- delay_octet$_{DS,0}$/2 = ***minimum*** *amount of memory in use* by VTU-R deinterleaver
- delay_octet$_{US,0}$/2 = ***minimum*** *amount of memory in use* by VTU-R interleaver
- delay_octet$_{US,0}$/2 = ***minimum*** *amount of memory in use* by VTU-O deinterleaver

159. G.993.2 states explicitly that the amount of memory ***actually used*** by a VTU-O or VTU-R to meet the specified delay_octet$_{DS,0}$ and delay_octet$_{US,0}$ values is implementation-specific. *See, e.g.*, *id.* ("Each interleaver and each de-interleaver for each latency path requires at least (delay_octet$_{x,p}$/2) octets of memory to meet this delay. The actual amount of memory used is implementation specific."). Thus, for example, to meet the aggregate interleaver/deinterleaver delay of delay_octet$_{DS,0}$, the memory used by the VTU-R to deinterleave the downstream latency path zero must be at least as large as half of the applicable end-to-end delay (*i.e.*, delay_octet$_{DS,0}$/2) in octets. Likewise, to meet the aggregate interleaver/deinterleaver delay of delay_octet$_{US,0}$, the memory used by the VTU-R to interleave the upstream latency path zero must be at least as large as half of the applicable end-to-end delay (*i.e.*, delay_octet$_{US,0}$/2) in octets. As G.993.2 makes clear, however, the VTU-R is free to use more memory than delay_octet$_{US,0}$/2 to interleave upstream latency path zero, and it is free to use more memory than delay_octet$_{DS,0}$/2 to deinterleave downstream latency path zero. Chapter 9 of *Fundamentals of DSL Technology*[7] explains that even memory-optimized interleavers and deinterleavers use more than the theoretical minimum amount of memory for interleaving and deinterleaving, and implementations may use significantly more than the theoretical minimum amount of memory (e.g., to provide a simpler or more flexible implementation). *See, e.g.*, Fundamentals at 262,

[7] *Fundamentals of DSL Technology* (Philip Golden, Herve Dedieu, and Krista S. Jacobsen, eds., Auerbach Publications, 2006) ("Fundamentals").

264. Therefore, simply knowing the value of $delay_octet_{DS,0}$ or $delay_octet_{US,0}$—or the downstream or upstream *I* and *D* values—is insufficient to determine how much memory the VTU-R is actually using, or has allocated, for, respectively, deinterleaving or interleaving.

160. The ***minimum total amount*** of memory the VTU-R must use to perform both interleaving and deinterleaving (assuming one latency path in each transmission direction) is $delay_octet_{DS,0}/2 + delay_octet_{US,0}/2$. G.993.2 § 6.2.8.

161. As noted above, G.993.2 contemplates, but does not require, that a VTU-O or a VTU-R might use shared memory for interleaving and deinterleaving. Therefore, G.993.2 also specifies that the total aggregate delay for all interleaving and deinterleaving, in both the downstream and upstream directions and over all latency paths, must be less than or equal to a specified number of octets. *Id.* In particular, the total aggregate delay must not exceed the number of octets specified for the parameter "aggregate interleaver and de-interleaver delay (octets)" for the selected profile. *See id.* § 6.1. This value is denoted as "MAXDELAYOCTET," and it sets a lower bound on the total amount of memory a VTU-O must have available for interleaving all downstream latency paths and deinterleaving all upstream latency paths, and a VTU-R must have available for interleaving all upstream latency paths and deinterleaving all downstream latency paths. For a VDSL2 connection having a single downstream latency path and a single upstream latency path, $max_delay_octet_{DS,0} + max_delay_octet_{US,0} \leq$ MAXDELAYOCTET. *Id.* § 11.4.2.7.

162. G.993.2 is explicit that the value of MAXDELAYOCTET establishes a lower bound on the amount of memory each of the VTU-O and VTU-R must provide to meet the specified maximum aggregate interleaver and deinterleaver delay: "The ***minimum amount of memory required*** in a transceiver (VTU-O or VTU-R) to meet this requirement is

MAXDELAYOCTET/2 octets. ***The actual amount of memory used is implementation specific***." *Id.* § 6.8.2 (emphasis added). In other words, the amount of memory a VTU-R must provide to meet the maximum allowed total delay is at least half of the number of octets listed for the parameter "aggregate interleaver and de-interleaver delay (octets)" of the selected profile in Table 6-1, but the amount of memory actually provided may be larger.

163. Dr. Cooklev states, correctly, that "max_delay_octet$_{DS,0}$" in field #8 of the O-PMS message "specifies the maximum delay for the VTU-O interleaver/VTU-R deinterleaver", and "max_delay_octet$_{US,0}$" in field #10 of the O-PMS message "specifies the maximum delay for the VTU-O deinterleaver/VTU-R interleaver." Cooklev Op. Rpt. ¶ 258. He then concludes, incorrectly, that "the maximum number of bytes of VTU-R deinterleaver memory is specified as one-half of max_delay_octet$_{DS,0}$ and the maximum number of bytes of VTU-R interleaver memory is specified as one-half of max_delay_octet$_{US,0}$." *Id.* ¶ 260. As I explained above, this conclusion is wrong. If the value of max_delay_octet$_{DS,0}$ in the O-PMS message specifies anything to the VTU-R about an amount of memory to be allocated to a deinterleaver, it specifies only a ***minimum amount of memory*** that must be available to the deinterleaver to meet the maximum allowed delay. Likewise, if the value of max_delay_octet$_{US,0}$ in the O-PMS message specifies anything to the VTU-R about an amount of memory to be allocated to an interleaver, it specifies only a minimum amount of memory that must be available to the interleaver to meet the maximum allowed delay. Contrary to Dr. Cooklev's assertions, the end-to-end downstream/upstream delay in octets sent by the VTU-O in the O-PMS message does not specify a maximum number of bytes of memory that are available to be allocated to a deinterleaver/interleaver. Indeed, the portion of G.993.2 Dr. Cooklev quotes as purportedly supporting his conclusion states just the opposite: "Each interleaver and each de-interleaver for